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Personalised Mobile Game Recommendation System

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ABSTRACT

The mobile games sector seems to be one of the fast growing industries due to the rising of mobile market. With the advancement of mobile technology, mobile devices can now be used as a mobile media centre. One of the emerging areas is also in using it for gaming, like a portable game console. However, players may have different preferences in what genres of games they will be more interested in at different time of the day. Furthermore, it can sometimes be difficult to use mobile internet to download the interested games at different time of the day. In this paper, a personalised mobile game recommendation system which takes into consideration the time-of-day and time-of-week is proposed. From the data collected, it can be seen that at different time periods users may download different games and from different game genres.

Categories and Subject Descriptors

H.4.m [**Information Systems Applications**]: Miscellaneous, H.5.4 [**Hypertext/Hypermedia**]: Navigation, H.1.2 [**User/Machine Systems**]: Human information processing

General Terms

Management, Design

Keywords

Mobile personalisation, Recommendation System, Games, Game theme, Mobile game.

1. INTRODUCTION

In recent years, it can be observed that there is a rising trend of mobile games developed for a huge range of mobile devices. During different time of the day, mobile device can also be used as an entertainment device for relaxation. Computer game has been viewed as an interactive media that is played most often when people have free time. Therefore it is easy to realize the impact by combining mobile phone culture and entertainment games. This leads to the popular trend in developing mobile games. Many mobile games have been developed in recent years. Some even transform popular console or PC games in the past to mobile platform. However, there could be too many games for mobile users to select. Additionally, users may prefer different mobile games at different time of the day. When users download games, too much time can be spent browsing content. The time use for browsing will be charged depending on the package data usage or time consumption according to network provider. Furthermore, many users have to pay for the game. Although some mobile games provide demo or trial version, the users still need to spend time browsing for something they like.

In this proposed recommendation system, the downloaded games should be considered as well as user's expected playing period. The theme of the game should also be taken into consideration. Eventually, the recommendation system will configure the game downloading menu via mobile internet. In addition, time and theme of game can be used primarily to predict user's needs. This will greatly reduce the browsing time the user spends searching for the type of games he/she prefers. In order to solve this problem, personalisation concept can be applied to the mobile game downloading menu. This paper presents the personalised mobile game recommendation system by using context information like time-of-day, day-of-week and the theme of the game. The system uses the context information to cluster and display appropriate menu to enhance the downloading speed. This paper also tries to reduce the need for the user to browse through several levels of menu in order to find what they want. Whenever user downloads the game, the menu that is able to meet the user's needs according to the context information will be displayed on the top of the menu. User can easily click to download or play the most desired game. The system can also identify the period used during weekend and time-of-day. In this paper, we have used a simple and straightforward technique which does not require a lot computation in the mobile device to present the most suitable games for the users. We work on a simple algorithm with the knowledge that the computing power on a mobile is always limited.

2. LITERATURE REVIEWS

2.1 Game theme

2.1.1 Game genre

There are many kinds of games that people like to play. They may play for different reasons such as relaxation, quick escape from real world or as a challenge. Some may like one game genre while some like another. Game genre or game theme seems to be the important factor in determining the user's needs. It is also suggested that some game themes are more appropriate for different time and location when putting in the mobile game context. The game genre can be divided into several kinds such as action, RPG, casual or adventure games. Each genre has its unique characteristics. For example in action games, the goals are to move and involve in the game at all times. There are many levels and it needs skillful hand-eye coordination and quick reflexes without much strategy. In contrast, RPG or Role-playing games take a long time to finish and its character can grow and improve in skill. The other interesting game genre is casual game.

This kind of game is easy to learn and not difficult to master. Importantly, it is often played in short bursts. The purpose of these games is for quick fun. Players want to get in and out quickly. In addition, puzzle games can also be challenging as well. It involves working on solving a puzzle without much storytelling. This genre of game is normally confined to just one screen. These two game genres seem to be suitable for mobile device.

2.1.2 Game genre and characteristic of the players

There is a relationship between the characteristic of each person and game genre, suggesting that different people may play different game genre. As a result, the mobile game provider should recommend the right game to the right people at the right time. There are researches related to this area such as Prensky's research [14]. The author claims that different game genres have different impact on the content of activities. The research also proposed several variables when selecting a game style including target group based on their age and gender. [16,17] studied the relationship of personal characteristic and game genres as well. It investigated the relationship of the appropriate game genre to learning theory and analysed the characteristics of game theme. The research found that game genre appeals to different people with distinct personal characteristic.

2.2 Personalisation

2.2.1 Overview

Due to an overload of information, personalisation seems to be the recommended solution in order to refine the problem of too much information. It can be used both on the web as well as the mobile internet. Jorstad et.cl. defined personalization [11] as a service and mechanism to allow user to adjust and adapt services to meet their needs. Additionally, other researchers found from the surveys that mobile users are keen to personalise their mobile phone [8]. The personalisation system can be referred in several ways. For example, in [10], the authors focused on devices personalisation where hardware and software capabilities such as display size, fonts, graphic, input device, language and time have been discussed.

2.2.2 Mobile personalisation

When focusing on mobile personalisation, it can be divided into 2 main types; content presentation and content visualisation. Firstly, content presentation is related to how the relevant information is gathered when presenting to the user. Factors related to user profile and other information such as ambience information which will be discussed in the latter sections are also included in this area of study [19,12]. Secondly, content visualisation is concerned with semantic zoom and drill down information on the chart for displaying on the screen [3, 4].

However, this paper is trying to solve the problem in terms of content presentation on downloading the game from the mobile menu.

2.3 Ambience information

This research is exploring the relevant factors in order to improve the accuracy of user navigation prediction and facilitate adaptive WAP menu for user. This can help user to reduce the clicks on their mobile device and reach the more interested content quickly. One important information which is related to content presentation is time. It can be classified by weekday or weekend with the information of the time-of-day. For example, context was described as a description of a situation similar to case-base reasoning when used in mobile [6,7]. The research suggested that system adaption is required for the change in the environment. Contextual information played an important role towards information retrieval in successive search. From [20], it can be seen that using time-framed information can improve the performance in the prediction of future browsing patterns. This research used time-framed separation of week and semester information using association rules. They also suggested that user would prefer different kind of information during different time of the day. This suggested that the displayed information on the mobile device should vary from time to time in order to match the users' need during different time of the day [12]. In [13], this research also used time-of-day as a factor to develop the personalisation system for mobile content presentation. It tried to re-arrange the main WAP menu for mobile customers in order to predict what the users would like during different time of the day.

2.4 User navigation prediction

User session means the time that user connects through the mobile internet for a specific time continuously. This is the time from the user starts the connection till the time it is disconnected from the server. The user session is normally shorter than web browsing on a desktop. It is mainly due to the reason that it is not so convenience when using mobile device for browsing. Therefore, if there is some mechanism to predict which contents or pages user will use in the session, it will facilitate user efficiency and reduce content access time. This can lead to higher user satisfaction.

The feature of hyperlink on mobile internet is often displayed as a menu lists or options on the mobile device. The user has to click the option or menu item of interest to go to the desired content. These options or menus are known as user navigation. As can be seen from the content presentation or content filtering on mobile internet, personalisation can be achieved by predicting user navigation.

The aim of the research in this area is to reduce the click distance of the mobile internet usage session between the first page menu and the desired option menu. It tries to display relevant topics which may be needed by the user in the shortest time [9,15,18]. Nonetheless most research focused on WAP portals and personalised levels of menu while our research is trying to propose the level-free content personalisation. In addition many works also implemented techniques such as Markov model, Bayesian network and Naïve Bayes to predict the user navigation using profiling data [1,5,22].

However, some complex computation may not be appropriate for small content providers that have insufficient information relating to user profile and user preference. With this reason, case-base

reasoning technique seems be common to provide mobile content personalisation.

3. RESEARCH METHODOLOGY

3.1 Experimental Design

The data of the research was conducted and gathered from the server log file of a mobile game provider in Thailand. The data in the log file was recorded in terms of mobile internet usage per session from the organisation's customer database. In addition, the log file also recorded the content name and content category of the company's file server and there were date and time usage information as well.

There were 25,699 records of users' sessions in the log file. This consists of 7,485 unique users. The user of the company can be divided into two types, specifically member and non-member. The member type customers can download unlimited content including Java games by monthly subscription. Therefore, this type of members is not too concerned about the number of downloaded games. However, they may be concerned with the difficulty in finding the interested game at the shortest time due to data charges. In contrast, non-members would be concerned about both the connection fee and finding the interested games fast. In Thailand, there are more pre-paid customers than post-paid customers. The pre-paid customers seem to be more restrictive with their budget than the post-paid customers as well.

The experiment was designed by adding the three main factors on the data in the log file which are day-of-week, time and game's theme. Firstly, the day-of-week data was separated into 2 types - weekday and weekend. For example, if the user downloads the games on Saturday and Sunday, these sessions would belong to weekend. Secondly, time-of-day would be inserted in the record. This can be divided into 4 periods - morning, afternoon, evening and night respectively. Finally, the content category was divided by game's theme. The overall process of the experiment will be discussed in the next section.

3.2 Process

Pre-processing phase is first carried out by gathering the log file. Then, the data was transferred to a database for the convenience of issuing queries. The data cleaning process is also an important process in this phase. There could be much irrelevant information in the log file and this process will eliminate those unwanted information. For example, users who are unable to download the game were removed from the database. Data conversion and formatting were performed as well. In the main process, classification of data based on the context information was implemented. Each important factor was used to classify the data in each group. The results were managed and sent to the user as a personalised downloadable game menu, which will be corresponding to the user's needs based on time information.
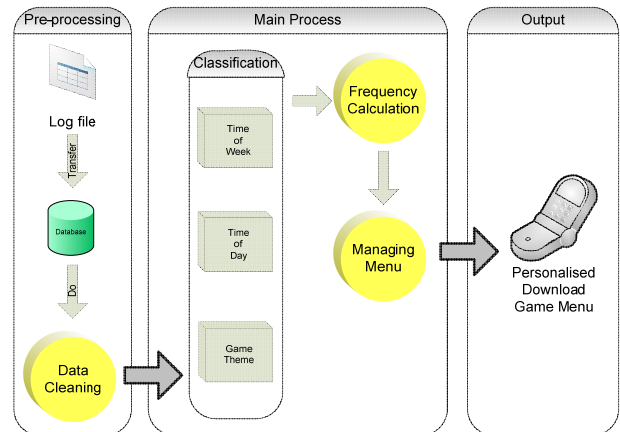

Figure 1. the downloading game menu process overview

4. RESULTS

4.1 Classification factors

Three main results related to the factors are tabulated in the tables. The first table (Table 1) shows that action game is the favorite game theme based on the time-of-week factor, topping at around 70% when compared with other themes. This is followed by casual, puzzle and adventure games at 10.99%, 7.03% and 5.30% respectively. The rank seems to be the same when compared across the weekday results except puzzle and adventure games, which have higher percentages. It can be seen that the RPG game is not a popular game theme for mobile game due to longer storytelling and time needed to complete the game. Therefore, in the downloading game menu during weekday, more games on puzzle theme may be added.

Table 1. Time-of-week and game theme factors

Game Theme	Weekend		Weekday	
	Frequency	Percentage	Frequency	Percentage
Action	5162	72.53%	7789	70.52%
Adventure	377	5.30%	619	5.60%
Casual	782	10.99%	1181	10.69%
Others	9	0.13%	36	0.33%
Puzzle	500	7.03%	872	7.89%
RPG	14	0.20%	16	0.14%
Strategy	95	1.33%	180	1.63%
Sports	178	2.50%	352	3.19%
Total	7117	100.00%	11045	100.00%

The next result used time-of-day factor which was also separated by time-of-week to rank the most downloaded game theme. It can be seen from Table 2 that there are different proportion of downloaded game theme in each period or time-of-day and in the time-of-week as well. The results are shown in the table below.

Table 2. Time-of-day and time-of-week factors

Time	Weekend								Weekday							
	1		**2**		**3**		**4**		**1**		**2**		**3**		**4**	
Game Theme	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Action	779	75.63	1532	75.17	1344	68.61	1507	72.11	1281	72.50	1862	71.64	2435	71.81	2211	67.24
Adventure	66	6.41	84	4.12	131	6.69	96	4.59	100	5.66	156	6.00	190	5.60	173	5.26
Casual	90	8.74	220	10.79	244	12.46	228	10.91	150	8.49	268	10.31	339	10.00	424	12.90
Others	4	0.39	1	0.05	1	0.05	3	0.14	6	0.34	6	0.23	8	0.24	16	0.49
Puzzle	51	4.95	133	6.53	151	7.71	165	7.89	118	6.68	196	7.54	261	7.70	297	9.03
RPG	4	0.39	6	0.29	3	0.15	1	0.05	3	0.17	0	0.00	8	0.24	5	0.15
Strategy	27	2.62	42	2.06	55	2.81	54	2.58	79	4.47	80	3.08	89	2.62	104	3.16
Sports	9	0.87	20	0.98	30	1.53	36	1.72	30	1.70	31	1.19	61	1.80	58	1.76
Total	1030	100.00	2038	100.00	1959	100.00	2090	100.00	1767	100.00	2599	100.00	3391	100.00	3288	100.00

After the time-of-week, time-of-day and game theme factors are calculated and sorted, we obtained the result of the proportion of downloaded games via mobile phone. The most popular game themes are action, casual, puzzle and adventure games. Importantly, if the menu uses the result from action game only, the other game theme would have less chance of being downloaded by the customers. Thus, to obtain well distributed opportunity, the proportion of the favorite games will be used as a guide in preparing the download menu. The menu items on mobile screen will be adapted according to time-of-week and time-of-day as well. Each game theme contains its own rank, and only those favorite game themes that are above a selected threshold will be displayed on the main downloading menu. It is worth noting that there is a quota for the providers to offer their games in each game theme to the customers. For example, action games will be given top 7 games in its container, while casual, puzzle and adventure games could have one game for their quota. This is done in a way that the service providers can manipulate the games available in the main downloading menu to increase profit.

4.2 Proposed downloading game menu

4.2.1 Proposed menu according to time-of-week

From the results obtained using time-of-week for clustering, we found that it is similar to using only time-of-week to re-arrange the menu. The results also show that it can increase the chance of downloading by giving the quota to bring the top rank in each category to the main downloading menu. On the other hand, if we use only frequently downloaded games, the games in other game genres will not be downloaded at all. Furthermore, the proposed menu system can be used and implemented for the personalised downloading mobile game system. It also facilitate user to download the more interested game according to their needs. Due to confidentiality, the actual game names cannot be disclosed in this paper. Therefore, game-ids will be used in this paper instead of the game names.

Table 3. proposed menu using time-of-week factors

Weekend / Weekday	
Game-id	**Game Type**
Game-041	Action
Game-160	Casual
Game-310	Action
Game-253	Action
Game-155	Action
Game-311	Action
Game-252	Action
Game-067	Adventure
Game-048	Puzzle
Game-245	Action

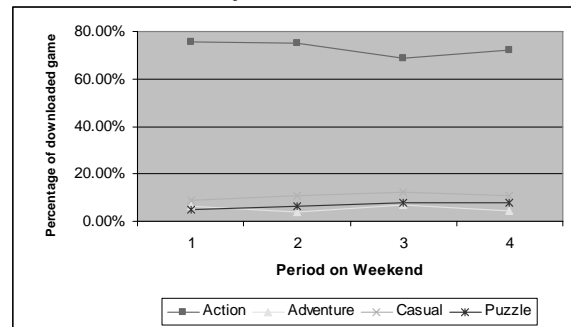### 4.2.2 Proposed menu according to time-of-day combined with time-of-week

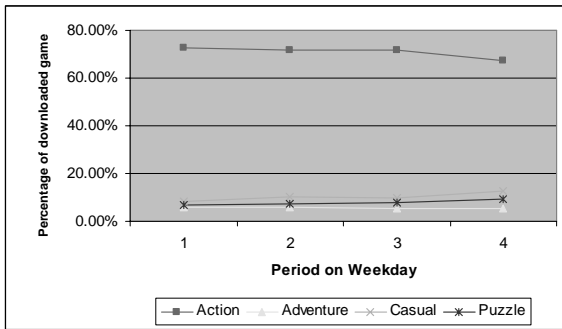**Figure 2. the trend to download game over the time period of weekend**

Figure 3. the trend to download game over the time period of weekday

As can be seen from figure 2, the graph shows that action games in period 3 of weekend tends to decrease. However, the percentage of casual game increases with puzzle game. The percentage on the adventure games fluctuated within the periods. As a result the weekend downloading game menu on the third period can be altered from the normal menu using time-of-week factors. When the quota of action game is decreased, the competition among other game theme will occur. The most frequently downloaded games at that time will have the place to show the downloading items or its name on the game menu. For the example, in the experiment, action game gains 6 places out of 10 while the other gain 1 place. Therefore, the second ranked games in each remained category are compared to find the maximum frequency in order to gain that place. The result shows that the second ranked game has the most frequency is in the puzzle game category. It can be seen from Table 3 in period 3 of weekend that at least 5 out of 10 ranking downloading game menu is different from the proposed menu using time-of-week factors. Compared to period 4 of weekend, the menu order is different from the period 3 and slightly different from using only time-of-week factor. Nevertheless, this can facilitate the user to download the more interested game to their mobile phone according to time-of-week and time-of-day. This can reduce the click distance to find the desired game and the scroll down levels to find the desire games.

Table 3. proposed menu using combination factors on weekend

Weekend Period 3 Menu		Weekend Period 4 Menu	
Game-id	Game Type	Game-id	Game Type
Game-041	Action	Game-041	Action
Game-160	Casual	Game-160	Casual
Game-310	Action	Game-310	Action
Game-253	Action	Game-253	Action
Game-067	Adventure	Game-155	Action
Game-155	Action	Game-311	Action
Game-311	Action	Game-252	Action
Game-252	Action	Game-048	Puzzle
Game-048	Puzzle	Game-067	Adventure
Game-068	Puzzle	Game-245	Action

On the weekday, it can be observed that the percentage of downloading action game has declined in the fourth period. In contrast, the percentages of downloading casual and puzzle games have increased.

Table 4. The proposed menu using combination factors on weekday

Weekday Period 4 Menu	
Game-id	Game Type
Game-041	Action
Game-160	Casual
Game-310	Action
Game-253	Action
Game-067	Adventure
Game-155	Action
Game-311	Action
Game-252	Action
Game-048	Puzzle
Game-068	Puzzle

5. CONCLUSIONS

This paper proposed a simple method to facilitate the user on mobile game downloading. The proposed method introduces a personalisation mobile game recommendation system using time-of-week and time-of-day information. Due to the increase number of mobile games being downloaded via mobile internet, it is getting more important to provide personalised experience. It can be observed that there are game genres preferences during different time depending on the context. In order to provide faster and personalised service, re-arranging the game downloading menu seems to be important for users. The simulation results are based on server logs collected from a mobile game provider in Thailand. As reported from the results, it is concluded that our assumption of the factors are valid. It is important to consider those context factors when creating personalization mobile game recommendation systems.

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